

Saturn Ring Seismology: Interpreting the Seismogram

Abstract (2,250 Maximum Characters)

Marley (1990) and Marley and Porco (1993) proposed that f-mode oscillations of Saturn could excite resonant density and bending waves in the inner C-ring. They hypothesized that certain wave features discovered by Rosen et al. (1991) that were not associated with known satellite resonances could be the result of such resonant interactions with the planetary oscillation modes. They also predicted that if this was the case the waves would be found to be density (and not bending) waves by Cassini and predicted the azimuthal wave number of the C-ring waves m . Employing Cassini VIMS stellar occultation data Hedman and Nicholson (2013) have now confirmed the predictions and demonstrated that at least some of the C-ring features identified by Rosen et al. are indeed likely caused by resonant oscillation modes of Saturn. Given this context we have taken a fresh look at the Saturn ring seismology. First we propose that an apparent bending wave denoted 'j' by Rosen may be a second order outer vertical resonance with the $l=3$, $m=2$ f-mode of Saturn and discuss the locations of other plausible second order resonances in the rings. Since only a handful of ring resonances have been identified, measuring even one or two additional planetary mode frequencies would substantially assist the process of inverting mode frequencies to constrain Saturn interior's structure. Using the available mode frequencies, modern inversion technique employed in stellar seismology, and a recent set of Saturn interior models we provide an initial estimation of what available mode frequencies are telling us about the interior structure of the planet. Since the f-modes are confined relatively closely to the planetary surface, most of the observed modes probe only the outermost layers of the planet that are already comparatively well understood. However the $l=2$ mode does probe relatively deeply into the planet and we will discuss the potential the measurement of this mode frequency has for placing new constraints on the interior structure.